CALIFORNIA OAK MORTALITY TASK FORCE REPORT
MARCH 2017

MONITORING

Of the 303 samples collected in the fall as part of the 2016 National *P. ramorum* Early Detection Survey of Forests, one AL sample was positive. A total of 611 samples were collected in 2016 from the nine participating eastern states (AL, FL, GA, MS, NC, PA, SC, TN, and TX). In total, 10 samples were *P. ramorum* positive – seven from three AL streams and three from one MS stream. No new positive locations were found as all positive samples were collected from streams associated with previously positive nurseries.

Sudden Oak Death (SOD) in East Bay Regional Parks – *Phytophthora ramorum* monitoring in the East Bay Regional Parks found the highest percentage of infection in Diablo Foothills Regional Park (near Walnut Creek) in stands with relatively low bay laurel density. Brice McPherson, David Wood, Maggi Kelly, and Greg Biging, UC Berkeley, share their observations.

East Bay Regional Parks SOD monitoring began with the installation of 537 georeferenced fixed plots in five parks between 2009 and 2011. Plots were randomly selected in coast live oak-California bay laurel stands in Tilden, Wildcat Canyon, Redwood, and Anthony Chabot Regional Parks and in Huckleberry Regional Botanic Preserve. Canyon live oak and California black oak are also present at the parks, but they represent < 1% of the oak population. In each 10-m radius plot, all coast live oaks were evaluated for SOD symptoms and overall health. *P. ramorum*-infested coast live oak symptoms were recorded for each plot by disease stage (early, late, dead) and disease severity was mapped. From 2015 - 2016, 60% of the plots in Redwood, Anthony Chabot, and Wildcat Canyon were revisited. Based on a partial re-measurement, infection rates were estimated to be 2.7% per year (Redwood), 3.6% per year (Anthony Chabot), and 3.8% per year (Wildcat Canyon). As of 2016, symptomatic dead coast live oaks constituted 8.9% (Anthony Chabot), 15.8% (Wildcat Canyon), and 16.8% (Redwood) of the mature trees (>20 cm DBH) evaluated. Based on the number of mature coast live oaks in these parks, the current estimated mortality by park is 22,000 trees in Redwood (85 trees/ha), 22,000 trees in Anthony Chabot (45 trees/ha), and 25,000 trees in Wildcat Canyon (81 trees/ha).

Diablo Foothills Regional Park (424 ha; contiguous with Mount Diablo State Park) is hotter and drier than the other East Bay hills parks surveyed. Blue oak (*Quercus douglasii*) is the dominant oak species, and bay are much less abundant than in the other parks. In August 2015, several coast live oaks at Diablo Foothills had symptoms consistent with SOD. Samples were collected from three trees and one was confirmed *P. ramorum* positive. In July 2016, 24 randomly selected fixed plots were established in coast live oak stands at the park, at a density similar to plots in the other parks. At least one symptomatic or dead coast live oak was identified in all but one plot. Despite the absence of *P. ramorum* from bay laurels in this area prior to 2016, 34% of the coast live oaks in the plots were symptomatic for *P. ramorum* and 6% were dead with late-stage SOD symptoms. These are the highest symptom levels observed in the East Bay parks being monitored. Symptomatic California black oaks were also present. Bay laurel was found in only 3 of the 24 plots and was represented by a single tree in two of the plots. The expectation that the recent drought would decrease the ability of *P. ramorum* to expand its range seems contradicted by its extensive presence in this park and the adjacent forests. This work was funded by the East

Bay Regional Park District. For more information, contact Brice McPherson at bmcpherson@berkeley.edu.

RESEARCH

Drake, B. and Jones, G. 2017. Public Value at Risk from *Phytophthora ramorum* and *Phytophthora kernoviae* Spread in England and Wales. Journal of Environmental Management. 191: 136–144.

Abstract: Heritage gardens, heathland and woodland are increasingly under threat from the non-native tree and plant diseases *Phytophthora ramorum* and *Phytophthora kernoviae*. However, there exist only limited literature that estimates the public non-market value that may be lost from a continued spread of *Phytophthora ramorum* and *Phytophthora kernoviae* into these habitats. This paper therefore uses a contingent valuation survey to assess the non-extractive public use and non-use values at risk from an uncontrolled spread of these diseases in England and Wales. Results estimate that £1.446 billion of public value is at risk in England and Wales per year from an uncontrolled spread of *Phytophthora ramorum* and *Phytophthora kernoviae*. The greatest public value at risk, of £578 million per year, is from an uncontrolled spread of these diseases to heritage gardens, while the lowest public value at risk, of £386 million per year, is from disease spread to heathland. The findings of this paper should help policymakers make informed decisions as to the public resources to dedicate towards *Phytophthora ramorum* and *Phytophthora kernoviae* control in England and Wales. In this regard, the current control programme to contain these diseases appears cost-effective in light of the public value at risk estimates produced by this paper.

Turner, J.; O'Neill, P.; Grant, M.; Mumford, R.A.; Thwaites, R.; and Studholme, D.J. 2017. Genome Sequences of 12 Isolates of the EU1 Lineage of *Phytophthora ramorum*, a Fungus-Like Pathogen that Causes Extensive Damage and Mortality to a Wide Range of Trees and Other Plants. Genomics Data. 12: 17–21.

Abstract: Here we present genome sequences for twelve isolates of the invasive pathogen *Phytophthora ramorum* EU1. The assembled genome sequences and raw sequence data are available *via* BioProject accession number PRJNA177509. These data will be useful in developing molecular tools for specific detection and identification of this pathogen.

Widmer, T.L. and Shishkoff, N. 2017. Reducing Infection and Secondary Inoculum of *Phytophthora ramorum* on *Viburnum tinus* Roots Grown in Potting Medium Amended with *Trichoderma asperellum* Isolate 04-22. 2017. Biological Control. 107: 60–69.

Abstract: *Phytophthora ramorum* is a concern of the ornamental nursery business because it is implicated in the movement on ornamental plants such as rhododendron and viburnum. Since there is a soil phase that infects the roots, above-ground symptoms are not often manifested and easily detected. Government agencies require that a *P. ramorum*-positive nursery be placed under some type of quarantine until it can demonstrate that it has mitigated *P. ramorum*. Typical methods of mitigation are often expensive, harmful to the environment, and impractical. Biological control using *Trichoderma asperellum* isolate 04-22 (Ta 04-22) has been demonstrated to reduce *P. ramorum* soil populations to below detectable limits when

incorporated into soil or potting mix. The purpose of this study was to determine whether Ta 04-22 would reduce *Viburnum tinus* root infection and reduce secondary sporulation from infected roots. When rooted *V. tinus* cuttings were planted into potting mix amended with three different final concentrations (1×10^5, 1×10^6, and 1×10^7 CFU/cm^3 potting mix) of Ta 04-22 and drenched with either a *P. ramorum* sporangia or chlamydospore suspension, plants with any infected roots declined as the Ta 04-22 concentration increased. This was significant ($P = 0.039$) when *P. ramorum* chlamydospores were used as the inoculum propagule but not ($P = 0.143$) when sporangia were used. A second application of Ta 04-22 as a top-dressing after 4 weeks did not result in a decrease in plants with infected roots. When *P. ramorum*-infected *V. tinus* roots were treated with Ta 04-22 grown on wheat bran, Ta 04-22 formulated as a wettable powder, or RootShield® Plus WP, flow-through of *P. ramorum* secondary inoculum was significantly reduced compared to non-treated controls ($P < 0.001$). A second application did not reduce the secondary inoculum any further. These results demonstrate that various formulations of Ta 04-22 and, to a lesser degree, RootShield® Plus WP can be used as a microbial biological control treatment to reduce infection of *V. tinus* roots by *P. ramorum* and reduce plant-to-plant spread by reducing secondary inoculum.

NORTH COAST SOD STAKEHOLDERS SURVEY FINDINGS

The University of California Cooperative Extension (UCCE), Humboldt and Del Norte Counties recently surveyed North Coast partners, collaborators, and stakeholders to gather input on the future direction of the North Coast SOD program. Together with their collaborators, UCCE has been formally engaged in SOD education, outreach, and management since 2004 with grant support from the USDA Forest Service, State and Private Forestry; CAL FIRE; and other agencies. The survey was prompted by challenges faced in recent years, including reduced funding for early detection monitoring as well as disease research and management, in addition to the perceptions of many that the SOD situation in California is too widespread and no longer possible to contain.

The online survey was sent to 65 landowners, natural resource managers, and professionals representing tribes, government agencies, non-profits, universities, and large and small private ownerships. Questions gauged future interest in various aspects of North Coast SOD efforts pertaining to education and outreach, monitoring, and management. Of the 33 respondents, all were in favor of continued support for the program. When asked if it was helpful and/or important to develop shared forest health-related management strategies across ownerships and landscapes, 100% responded yes; however, of that 100%, almost half responded that this was difficult to achieve.

Based on the overwhelmingly positive responses to this survey, UCCE staff will continue to pursue funding to support the North Coast SOD program and will continue to work to foster relationships and efforts across ownerships and landscapes to strategically address SOD. Improved efforts to communicate successes and opportunities to address fatigue issues will also be incorporated into the program. The discovery of the EU1 strain of the pathogen in Curry County in southern Oregon may help foster a renewed and strengthened collaborative effort to combat this imminent threat to California's forests. For more information, contact Yana Valachovic at yvala@ucanr.edu.

RELATED RESEARCH

Burgess, T.I.; White, D.; McDougall, K.M.; Garnas, J.; Dunstan, W.A.; Català, S.; Carnegie, A.J.; Worboys, S.; Cahill, D.; Vettraino, A.M.; Stukely, M.J.C.; Liew, E.C.Y.; Paap, T.; Bose, T.; Migliorini, D.; Williams, B.; Brigg, F.; Crane, C.; Rudman, T.; and Hardy, G.E. St. J. 2017. Distribution and Diversity of *Phytophthora* across Australia. Pacific Conservation Biology [Online Early]. http://dx.doi.org/10.1071/PC16032.

Kunadiya, M.; White, D.; Dunstan, W.A.; Hardy, G.E. St. J.; Andjic, V.; and Burgess, T.I. 2017. Pathways to False Positive Diagnoses Using Molecular Genetic Detection Methods. *Phytophthora cinnamomi* a Case Study. FEMS Microbiology Letters. DOI: 10.1093/femsle/fnx009.

Miles, T.D.; Martin, F.N.; Robideau, G.; Bilodeau, G.; and Coffey, M. *In press*. Systematic Development of *Phytophthora* Species-Specific Mitochondrial Diagnostic Markers for Economically Important Members of the Genus. Plant Disease. http://dx.doi.org/10.1094/PDIS-09-16-1224-RE.

Rolando, C.A.; Dick, M.A.; Gardner, J.; Bader, M.K-F.; and Williams, N.M. 2017. Chemical Control of Two *Phytophthora* Species Infecting the Canopy of Monterey Pine (*Pinus radiata*). Forest Pathology. [Early View] DOI: 10.1111/efp.12327. http://onlinelibrary.wiley.com/doi/10.1111/efp.12327/full.

Sheremet, O.; Healey, J.R.; and Quine, C.P. 2017. Public Preferences and Willingness to Pay for Forest Disease Control in the UK. Journal of Agricultural Economics. [Early View] DOI: 10.1111/1477-9552.12210.

NORS-DUC CORNER

A case study - *P. ramorum* spread from an infected California bay laurel tree to rhododendrons under ambient conditions is being studied this winter at the National Ornamentals Research Site at Dominican University of California (NORS-DUC). Beginning on November 17, 2016, two potted rhododendron plants per rain event were placed under a *P. ramorum*-positive bay tree on the Dominican University campus (San Rafael, CA). Water samples were collected from buckets hung in the canopy of the bay and from buckets on the ground next to the rhododendron plants. The presence of *P. ramorum* in the rainwater was determined after each major rain event using direct plating and baiting. Rhododendrons that developed *P. ramorum* symptoms were replaced with new, healthy plants. *P. ramorum* was detected consistently from rainwater in the canopy after the first rainfall on November 21st; whereas, rainwater collected at ground level was found positive for the first time on December 12th after four rain events. The first symptomatic rhododendrons were detected on December 19th and symptoms continued to appear thereafter. Daytime temperatures ranged from 10-19° C and nighttime temperatures ranged from -0.9-12° C. The results support earlier observations that prolonged periods of rainfall and cool temperatures are needed for inoculum build up and subsequent spread of *P. ramorum* to rhododendrons.

CALENDAR

3/19 – 3/25 - 8th Meeting of IUFRO Working Party 7.02.09: *Phytophthora* in Forests and Natural Ecosystems; Sapa Vietnam; For information or to register, go to http://www.iufrophytophthora2017.org/.

3/28 – 3/30 - 63rd Annual Conference on Soilborne Plant Pathogens (formerly Soil Fungus Conference) and the 49th Annual California Nematology Workgroup; University of California, Davis; For more information or to register, go to http://soilfungus.wsu.edu.